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A GEOGRAPHIC STUDY OF DULUTH

BY

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Introduction. The City of Duluth holds a rather unique position among the cities of the country because of its youth, its rapid growth, and its association with one of the world's most important resources. Its location, topographically, geologically and climatically, as well as geographically, brings about a combination of conditions which arouses the interest of nearly all its visitors. These conditions are worthy of special consideration because they are so clearly bound up with the geography of not only the locality itself but a vast territory immediately adjacent. The city has had an exceptional, though conservative growth. On the one hand, it shows distinctly the characteristics of a small city; on the other hand, it displays the spirit of a metropolis, and in many respects exhibits the characteristics as well.

To the student of geography it presents not only a most fascinating study but offers an opportunity for a practical geographic study. With the idea of combining both the theoretical and the practical, this paper has been prepared. Not only has the unsatisfactory "boom" literature been thoroughly studied, but individuals have been interviewed who have witnessed the city grow, who have played an important rôle in its growth, and who even to-day have a hand in shaping its destiny.

Location. Duluth is located in latitude 46° 48′ north and longitude 92° 6′ west. It lies on the western shore of the southwestern end of Lake Superior. At this place the tapering extension of the

world's largest inland lake ends in a bay which, with its protecting spits and bars, forms one of the world's most efficient harbors (Figs. 1-3).

The city lies in the northeastern part of Minnesota, at the mouth of the St. Louis River, and at the head of navigation on Lake Superior. It is essentially in the center of the North American continent and in the extreme north central part of the United States. Therefore, so far as mere geographic distance is concerned, Duluth is close to all important points in North America and easily accessible from all directions—a decided advantage.

Topography. Although situated on a lake shore, it is not upon a flat. In fact, the larger part of the city is located on the southeastern slope of a rather steep range of hills which parallels the lake shore (Fig. 2). The range is steepest at a point opposite the industrial center of the city, that is, opposite Rices Point. Immediately to the southwest and to the northeast the gradient of the slope becomes less steep. A few creeks dissect the hillside, increasing the steepness of the gradients in places, thereby adding considerably to the scenic beauty. Practically the only flat land is that on Minnesota Point, Rices Point, and a narrow strip bordering the western bank of the St. Louis River. This distribution of hill and flat has constituted an advantage at times, and again a distinct handicap.

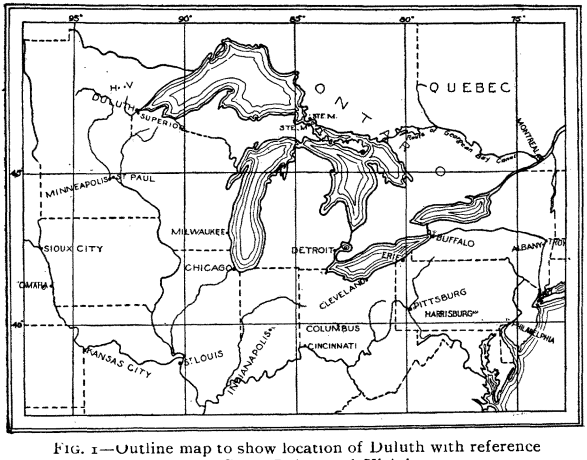

FIG. 1—Outline map to show location of Duluth with reference to the Great Lakes and Vicinity.

The shape of the city is elongate; its maximum length, 20 miles, is about four times its maximum width, 5 miles (Fig. 3).

Geology. The geology of the Duluth region is very complex. In this discussion only the larger factors are noted (Fig. 2). The basic rocks are among the oldest known on the earth's surface, belonging to the Keweenawan formations of the Proterozoic era.*

* Chamberlin and Salisbury Geology, Vol. II, pages 148–149, 1904.

The rocks are primarily lavas, gabbros, diabases, basalts, and other igneous formations, most of which possess a schistose structure. Economically, these rocks are a hindrance, as their extreme hardness and lack of natural lines of fracture make excavations in them most difficult, and therefore expensive.

All of the area was glaciated by the great continental ice sheet which came from Canada and moved over approximately the northern half of the United States (Fig. 4). Glaciation has had an important influence upon the locality. While the hills were worn down considerably, yet deposits of a heavy red boulder-clay, or till, were laid down in isolated areas within the city limits and over rather extensive areas just outside of the city.

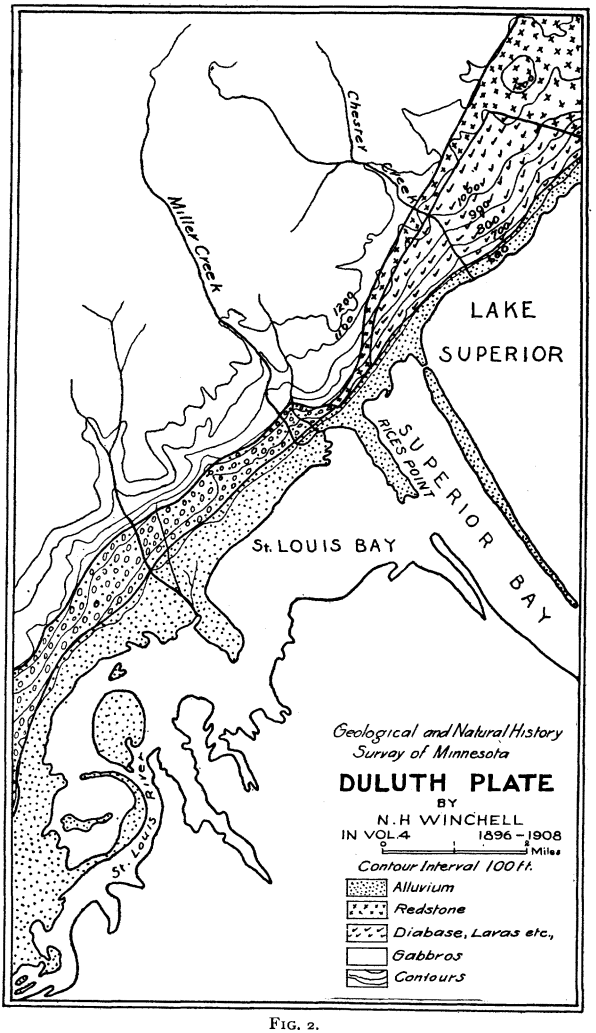

FIG. 2.

The water from the melting of the ice sheet did not at first recede to the present level of Lake Superior, but remained at a height of about 534 feet above the present level. At this height a beach was formed,* remnants of which can still be traced. At an elevation of

*N. H. Winchell, Geological and Natural History Survey of Minnesota, Vol. IV, 1896–1898.

about 475 feet (Fig. 5) another beach is located, indicating the fact that the lake must have remained at this level for a long period. The citizens utilize this beach as a driveway, calling it the Boulevard Drive. It extends essentially the entire length of the city. The view from it over the city and lake is a great source of pleasure to the citizens, as well as visitors to the city, who invariably are taken upon a tour of this road. A series of lesser beaches are discernible in part down to the present level of the lake. In some instances these beaches have determined the courses of the streets of the city.

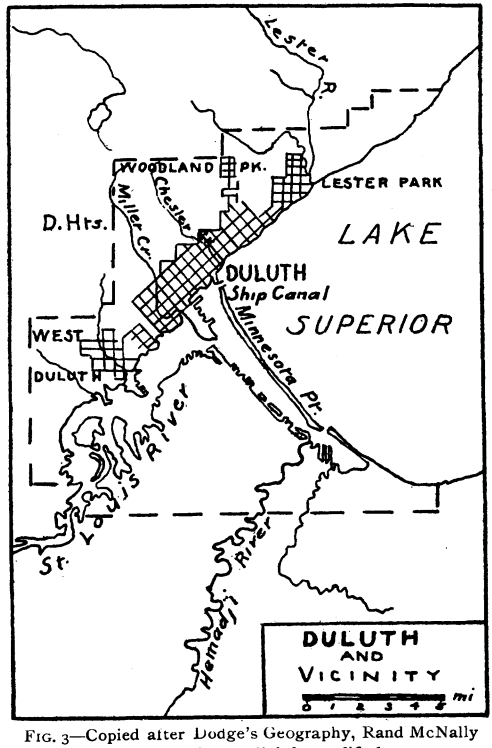

FIG. 3—Copied after Dodge's Geography, Rand McNally & Co., Chicago, slightly modified.

It is worth while here to mention the geology of the region just back of Duluth, for this hinterland, covering a radius of 100 miles, is in large part responsible for the city's growth. The rock-mass is somewhat similar to that at Duluth, but is considerably older. In the vicinity of Hibbing, Virginia and Tower the deposits consist of Huronian and Laurentian granites primarily, with greenstones, slates and conglomerates. It is in the former igneous rocks that the world's richest known deposits of iron ore occur.*

On the glacial till deposited in this area has grown an extensive forest that has given rise to the vast but now waning lumber industry of Northern Minnesota. Now that the forests are being removed, the possibility of the soils for agricultural production looms up as a remaining resource.

CLIMATIC CHARACTERISTICS

Temperature. Duluth is in the Intermediate or Temperate Zone. It is just about in the center of this zone, within the path of high-

*Van Hise and Leith, *U. S. G. S. Bulletin* 360, "Pre-Cambrian Geology of U. S.," Map (p. 330).

est frequency of the continental high pressure (Highs) and low pressure (Lows) storm areas. The temperature to be expected would therefore show a considerable range, both daily and annual. Fig. 6 indicates the variation in the average temperature for the twelve months of the year. January is the coldest and July the warmest month. Spring is cooler than autumn, as shown by the relative lengths of the curves connecting the temperature of the winter months with that of the summer months and the temperature of the summer months with that of the winter months.

While averages are useful for some purposes, they do not always describe a situation as truly as extremes which make up those averages. Therefore, it has been deemed worth while to show the variations in the absolute extremes of temperature for the months of the years 1901-1910 inclusive* (Fig. 7). These diagrams define clearly the fact that the temperature always falls to slightly below —20° F. at least once during the winter. This low temperature may be expected in January or February. On the other hand, the highest temperature may reach 98° F. at least once during the summer months, usually in July. It should be noted that the low temperatures occur nearly always in the early hours of the morning, and that as soon as the sun rises well above the horizon the temperatures rise rapidly; hence, the citizens are rarely exposed to the lowest temperatures (Fig. 8). This is a very significant fact, because the climatic reputation which any locality may have should not be established on a basis of absolute extremes of temperature as recorded during the hours of the night, but rather upon the temperatures which any individual must endure during the working hours of the day. On this basis alone, even neglecting other climatic factors,

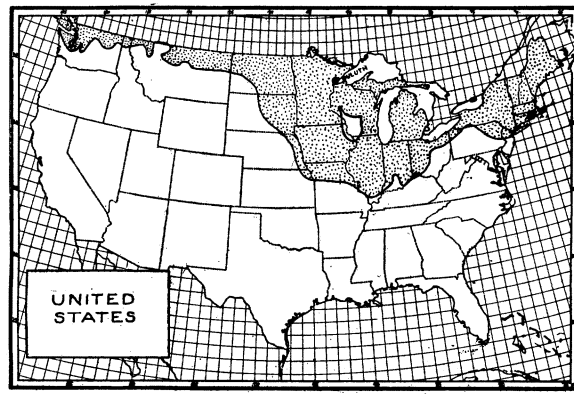

FIG. 4—Duluth and the Glacial Soils in the U. S. Sketched after map, p. 331, Vol. III, Chamberlin and Salisbury's Geology.

* The highest temperature recorded during the past forty years is 99° F., as observed on July 1, 1883. The lowest recorded temperature for the same period is —41° F., recorded January 2, 1885.

the range of temperature in Duluth is not severe. It may be described as a range sufficient to instil briskness and vigor in the individual and to stimulate him to activities which make for progress.

The temperature extremes at Duluth are not as wide as they are at distances of 50 or 100 miles westward, because of the presence of Lake Superior. During the summer time the waters of the lake are quite cold. Winds blowing over the lake upon the land, therefore, are cooling winds. During the winter months the winds are prevailingly from land to the water; the humid air over the lake is blown away from the land, leaving the air over the land with low humidity; hence, the low temperatures cause no suffering. Although the relative humidity is rather high during the summer, the temperature is relatively low; hence, the sensible temperature is not oppressive, but quite comfortable.

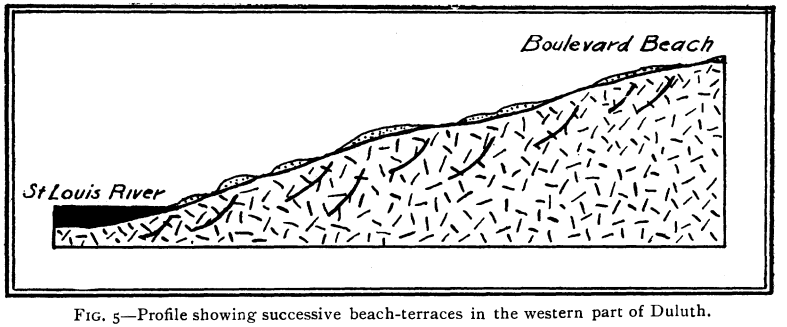

FIG. 5—Profile showing successive beach-terraces in the western part of Duluth. (Geography of Minnesota, p. 206, Hall, 1903.)

The city is built on the slope of a range that extends in a northeast-southwest direction, and rises to a height of about 500 feet above the lake level. Because of this sloping surface the angle which the sun's rays makes with it brings about temperature conditions different from those that would obtain were the surface level. The cold of the winter months is moderated and the heat of the summer is tempered.

Winds. The prevailing wind direction is northeast, the average wind velocity being about 13.5 miles per hour (Fig. 9). It is argued by some that such a wind is sufficient to cause unusual activity among the inhabitants. As one finds it necessary to walk almost daily against a moderate breeze, the resultant energy acquired soon develops into a valuable asset. A brisk breeze also maintains a constant circulation of the atmosphere, thereby preserving its freshness and purity.

Inasmuch as Lake Superior is cooler than the land throughout

the entire year, the prevailing northeasterly winds insure comfortable days during the summer time. During the winter months the winds are mostly from the northwest; therefore, the presence of the cool body of water has little effect upon the temperature.

Rainfall and Humidity. The annual precipitation for Duluth equals 29.61 inches. The minimum, most of which is in the form of snow, occurs during the winter months and early spring. During the summer months, June to September, the maximum amount of rain falls. Comparing this distribution with that of temperature (Fig. 6), it may be readily observed that the variations in these two

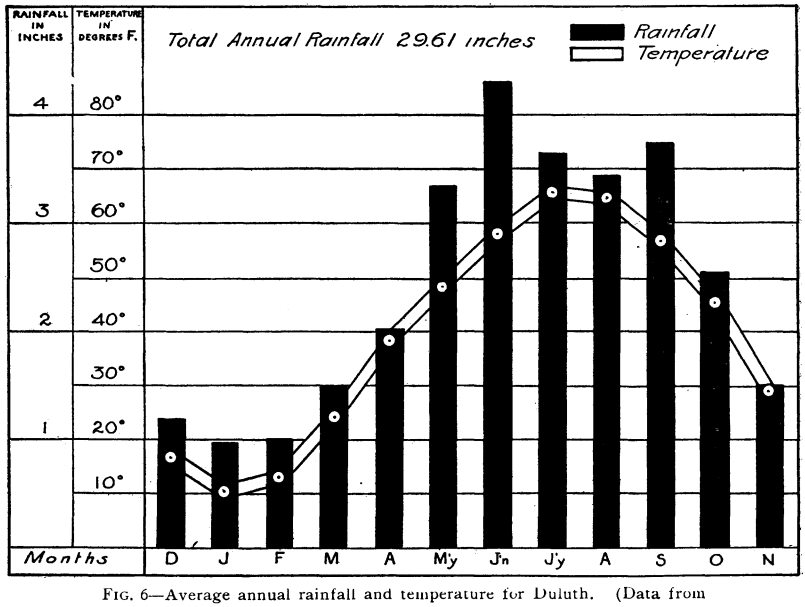

FIG. 6—Average annual rainfall and temperature for Duluth. (Data from U. S. W. B., Duluth, Minn., average for forty years.)

elements are parallel and nearly equal. At no season are either temperatures or rainfall excessive. The relative humidity, therefore, is not high. As a matter of fact, for the twenty years 1888-1907 inclusive it averages 75.8 per cent. It is lowest in May (69.8 per cent.) and highest in December and January (80.8 per cent. and 80.3 per cent., respectively). Given these elements of rainfall, temperature and relative humidity so normally balanced in a region with a rich soil surface, cultivation of certain hardy products on an extensive as well as intensive scale becomes possible.

Snowfall. Because of the northerly latitude and occasional heavy snowstorms, Duluth is reputed to lie within a snow-bound

area during the winter season. It must be remembered that although severe storms occur, they are the exception and not the rule. The snow covering, on the level ground, from November to May ranges from five to fifteen inches. During abnormal years the depth of

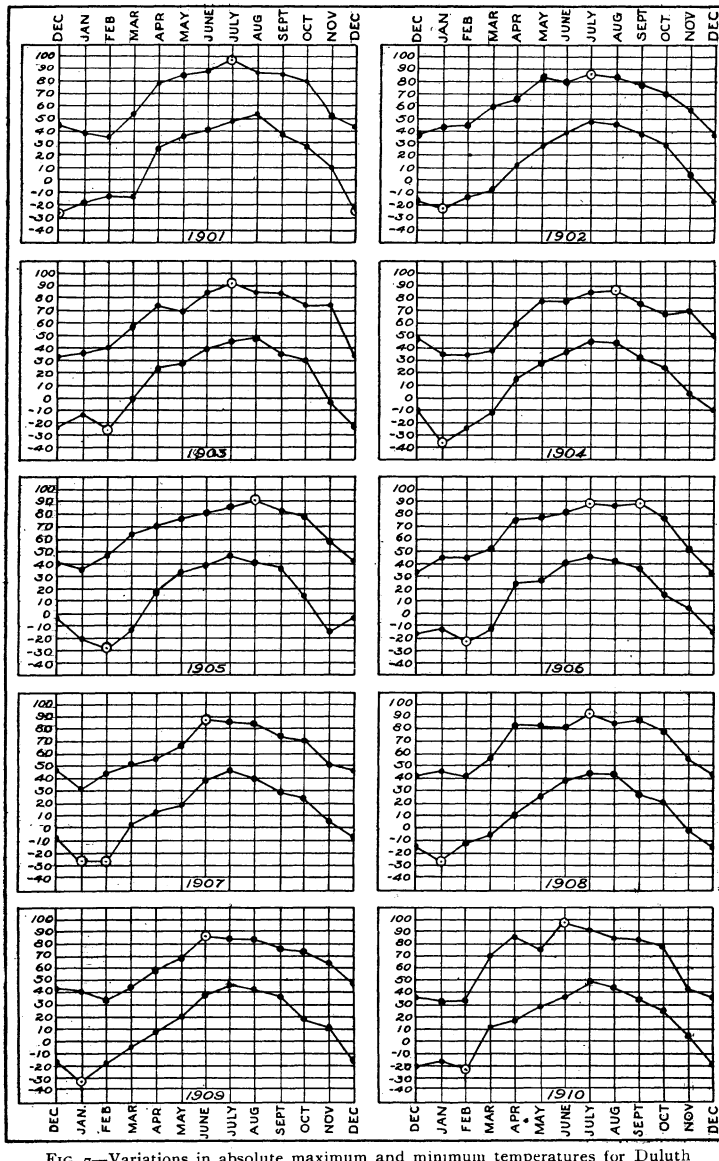

FIG. 7—Variations in absolute maximum and minimum temperatures for Duluth for years 1901–1910. (Data from U. S. W. B., Duluth.)
Upper curve=maximum temperatures.
Lower curve=minimum temperatures.

snow on the level ground may exceed this range by five or ten inches; however, this condition occurs so seldom it may be considered but a minor factor. With the modern devices at hand the larger cities and the railroads connecting them are able to care for

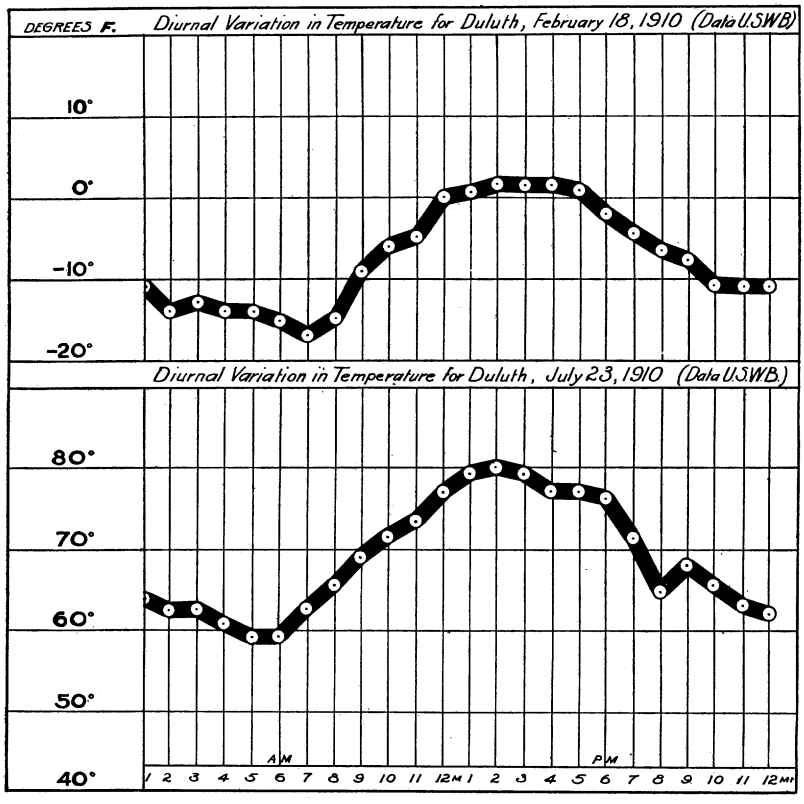

FIG. 8—Showing low temperature in the morning, rapid rise during the day and subsequent fall at night.

themselves very successfully during these winter seasons. Therefore cold, snowy winters, so far as concerns the land area about Duluth, are no great handicap to the city's progress.

Climatic conditions work a hardship upon Duluth in one important respect only. Much of the growth of the city is dependent upon

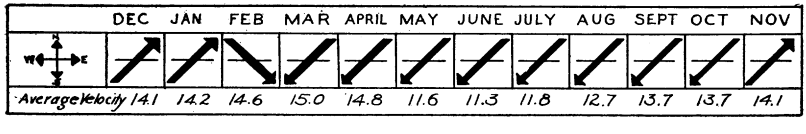

FIG. 9—Prevailing wind. (Data from U. S. W. B., Duluth, Minn., 1904–1910.)

the facilities for navigation. Although Duluth harbor is open practically the year around,* boats which must ply between Duluth and the ports on the lower lakes must close their season at the end of eight months of navigation because of the freezing of the waters at Sault Ste. Marie. Thus, Duluth is handicapped if its boats must cease intercourse during four months of the year. Looking generations ahead, it is not altogether impossible that some means will be provided to keep open the St. Mary's Canal at Sault Ste. Marie even during severe winters, thereby materially lengthening the season of navigation.

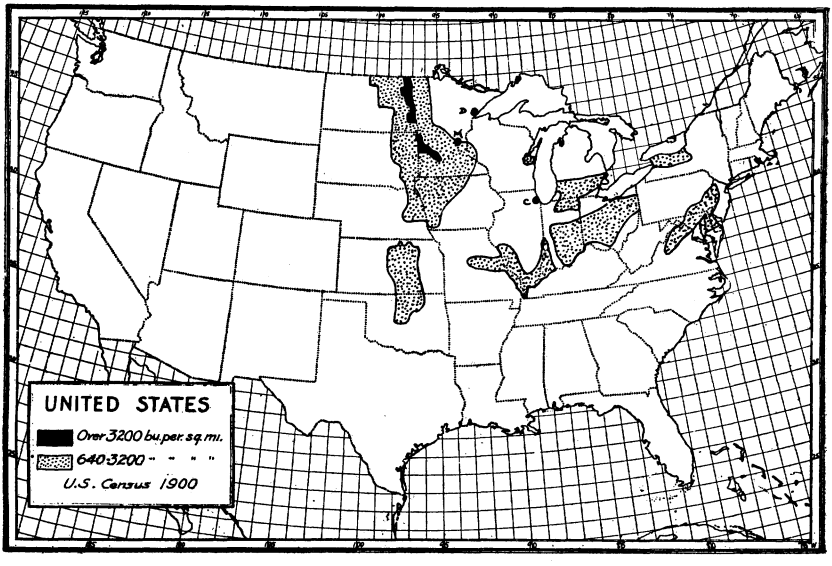

FIG. 10—Principal wheat fields in Central and Eastern U. S.

NATURAL RESOURCES

The natural resources of any locality are always either a positive or a negative factor in its development. These resources may be agricultural, mineral, a combination of both, or neither one, but just facilities for collecting and distributing commodities. Duluth possesses neither of the former on a large scale. The timber that was on the site of Duluth has been a resource worth while, but its disappearance now leaves the city without any extensively developed natural product which it may claim its own. If the city is a distributing center, what does it distribute and whence come the materials?

Agricultural Products. Duluth ships large quantities of wheat,

*See discussion under The Harbor and Water Transportation.

flax, barley, oats, rye, flour and lumber.* Of these commodities, probably that one which leads in Duluth commerce is wheat. The principal productive areas are shown in Fig. 10. The Red River Valley of the North, eastern North Dakota and part of eastern South Dakota ship wheat to the Eastern markets via Duluth and the Great Lakes. By far the greater amount of wheat goes to the East via Minneapolis, although Duluth is the natural geographic center for distribution of wheat to Eastern points. However, things that logically are due individuals or communities are not always secured by

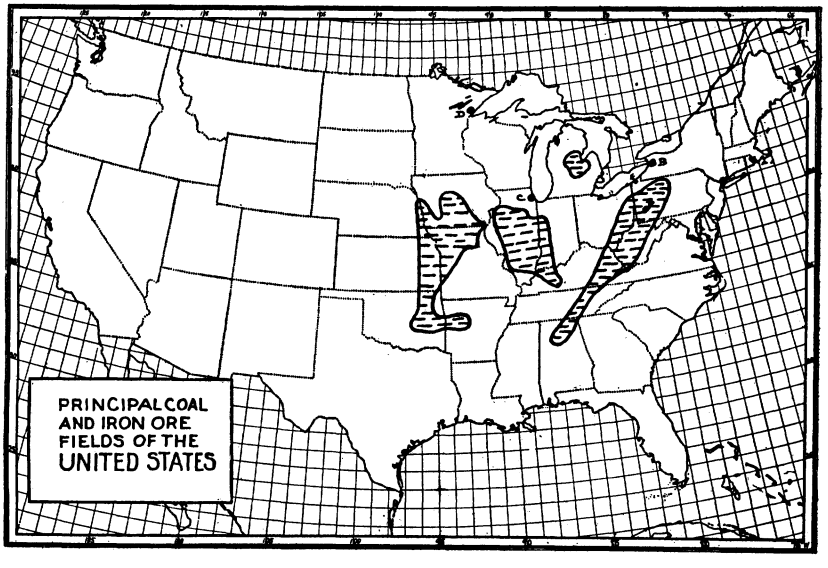

FIG. 11.

them. Railroad rates in many instances have been discriminatory against Duluth, resulting in the diversion of much traffic along other routes. This is an excellent illustration of the influence of artificial factors upon natural geographic conditions resulting in the destruction of the latter. Wheat, a product which should not only add materially to Duluth's welfare but be one of the principal stimuli in its growth and permanence, becomes of relatively little significance. Of the other products, none excepting lumber has held a place of unusual importance in Duluth's commerce. With the disappearance of the forests, the lumber market must disappear.

* In 1910 the following shipments were made: Wheat, 15,091,000 bushels; Flax, 2,118,520 bushels; Oats, 1,186,547 bushels; Barley, 926,222 bushels; Rye, 121,000 bushels; Flour, 1,587,611 barrels; Lumber, 260,678 M feet, Board Measure. Marine Commerce, Duluth-Superior, 1910. G. D. Fitch, Lieut.-Col. U. S. Engineers, Duluth.

A review of the entire list of the agricultural products named above makes striking the fact that the variety, as well as quantity, is small. This limitation necessitates the importation of foodstuffs in large quantities into Duluth for the use of its own citizens. Clearly,

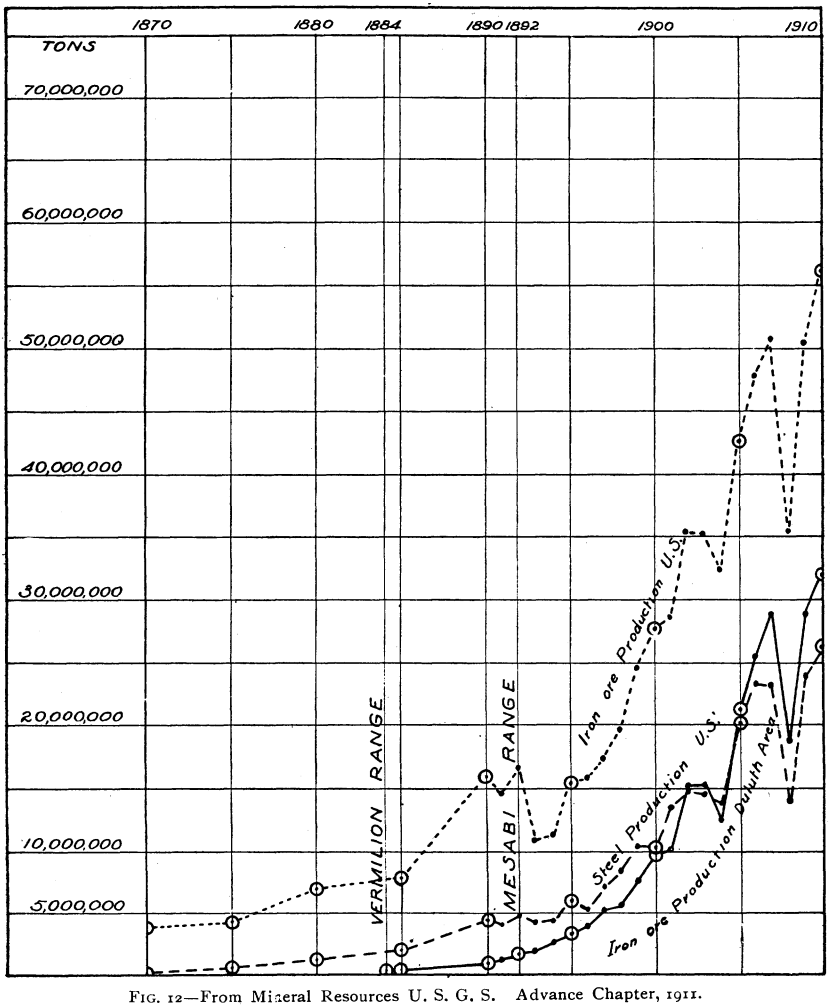

FIG. 12—From Mineral Resources U. S. G. S. Advance Chapter, 1911.

then, Duluth cannot be called an agricultural city, and its rise cannot be attributed in any way to its agricultural environment. If agricultural resources have not played a significant part in Duluth's history, then only one other material resource remains, namely, mineral.

Mineral Products. Within a radius of 100 miles of Duluth is found over three-fourths of the iron ore deposits of the United States. These deposits do not occur in conjunction with coal or limestone, both of which are essential for the manufacture of iron ore into steel. The latter are found in the Pittsburg area. The iron ore can be transported by rail to the head of the Great Lakes, shipped by boat—the cheapest means of transportation—to ports on Lake Erie, and thence to Pittsburg (Figs. 1 and 11). Copper is the only other valuable metal found near Duluth; this is shipped in very small quantities.

Proofs of the significance of iron ore in the world's activities need not be dwelt upon. Suffice it to say: "Next to coal, iron is clearly

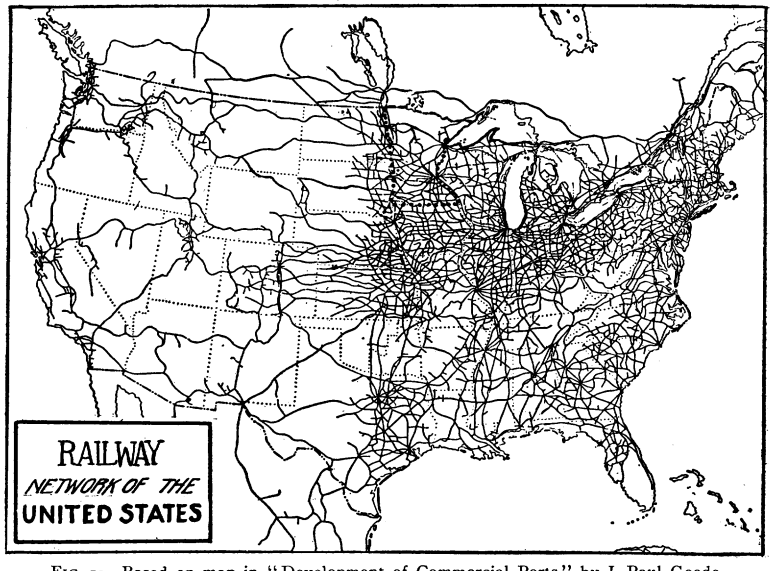

FIG. 13—Based on map in "Development of Commercial Ports" by J. Paul Goode. Chicago Harbor Commission Report.

the most important of the sub-surface products."* This product, fortunately, is located near a water highway that will carry it to the coal and limestone fields necessary for its manufacture. Where the ore breaks bulk—that is, is transferred from train to boats—there will necessarily rise a community of people employed to do the work of transfer. That point in this vicinity has been Duluth, and there Duluth has risen and will continue as long as the iron ore resource lasts.

Ore Production. How large a factor the iron ore of the Vermilion and Mesabi ranges has been in the production of iron ore

* Van Hise, "Conservation of Natural Resources," p. 62.

and steel for the whole United States is shown in Fig. 12. The sudden fall in the curve in 1892-3 is a response to the panic of that period. In addition to that fluctuation, the very rapid rise in the curves for steel and iron ore production for the United States is notable after the opening of the mines northwest of Duluth in 1884 and 1892. Only twice after the opening of these new mines was there a decrease in ouput, namely, in 1904 and 1908. The curve for total production in the United States corresponds exactly in its fluctuations, after 1893, with the curves for the output of the Duluth ranges—an indication of how closely the total output of the United States is related to the output in the Lake Superior district. The production of steel varies essentially in the same manner.

Commerce

The commerce of any city may consist in the exchange of only one kind of product for one from some other region, or it may include the exchange of a great variety of products. These products of exchange may be its own—that is, produced within its own property limits—or they may belong to another city, or other cities. While much of the capital which controls the mines upon the ranges is held by citizens of Duluth, Duluth cannot claim complete ownership to the mines, as a very considerable part of them are owned by Eastern capital. The variety of commodities in the commerce of any city may include largely mineral resources and only small quantities of agricultural products; or it may include agricultural products wholly to the exclusion of other commodities. A number of other combinations still are possible.

Commerce with the East. Duluth may be looked upon fairly as a point for the breaking of bulk of products passing from the Northwest to the East, and not in general as an owner or producer of the commodities shipped. It may be classified with the cities that have the balance distinctly in favor of mineral output as a dominant factor in this commerce. In return for its iron ore it receives principally coal. Coal is brought back from Eastern ports because it is lacking in Duluth and the Northwest, and is therefore of high value in this part of the country.

Commerce with the West. Because of the lack of coal resources in the Northwest, and because the boats returning from the East bring back coal, Duluth becomes the coal-distributing center for the Northwest.* Because of the cold seasons of the Northwest

*Superior, Wisconsin, across the bay from Duluth, shares equally with Duluth in the matter of coal distribution.

and the rough country, where the explorer and settler are still at work establishing civilization of the modern type, heavy clothes are essential for protection against many of the hardships which these people must still endure. In consequence, Duluth possesses an establishment which specializes in the manufacture of heavy clothing. Again, the number of retail clothing establishments is rather large in proportion to the size of the city—a direct response to the rigor of the unsettled country of the Northwest. A total of seventy-five

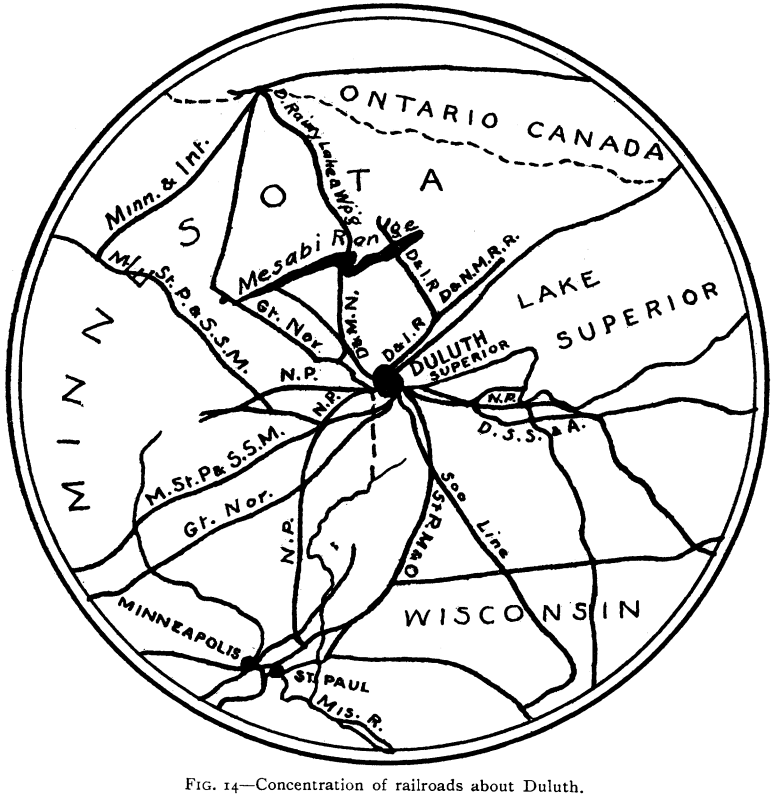

FIG. 14—Concentration of railroads about Duluth.

clothing establishments gives an average of about one per 1,000 population.

The jobbing of hardware is conducted by two of the largest hardware companies in the United States—a response to an agricultural country which needs implements and utensils of almost every variety, for both outdoor and indoor work.

Four large wholesale, as well as a few retail grocery establishments, distribute their products throughout the Northwest, thereby

supplying the deficiency in variety of foods. The combination of soil and climate is such as to make the growing of grains the most profitable in the list of crops that might be cultivated in this region. Hence, few plant foods are especially grown for the immediate use of the inhabitants. These products of the soil they are satisfied to import from other parts of the country. The principal products included in Duluth's commerce with the West may be summarized as coal, clothing, hardware and groceries.

Commercial Facilities

Railroads. By virtue of its location at the head of the lakes, that is, at the head of a cheap avenue of transportation to the East, and by virtue of the geographic advantages for distribution

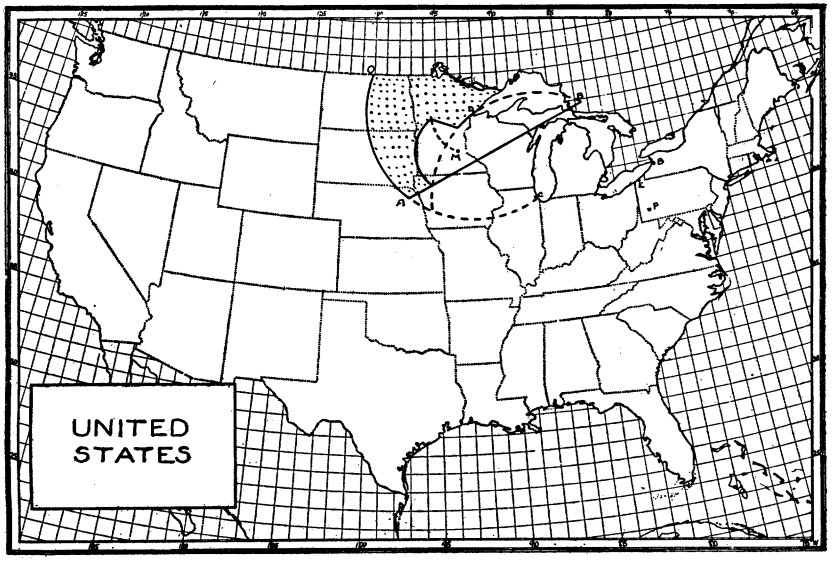

Fig. 15—North of the line A–B territory is nearer Duluth than Chicago. Dotted area is territory to which Duluth is entitled exclusively or should be on an equal competitive basis with Minneapolis and St. Paul. Territory west of curve A–O, in the Dakotas, Northern Wyoming and Montana is tributary to Duluth.

to the West, fourteen lines of railroads radiate from Duluth (Figs. 13 and 14). Fig. 15 indicates the extent of territory which is geographically tributary to Duluth and with which Duluth is in communication. The dotted area should ship its products to Duluth for transportation to the East, because this is most economical for the shipper. Recognizing, however, the fact that trade does not

always follow geographic lines, but is often controlled in its direction by prestige of one route over another, by competition and other artificial influences, the route to the East via Minneapolis and Duluth, or Minneapolis and Chicago, may be justifiable. It has been shown* with regard to rates between the East and the Twin Cities, and also with regard to rates between points in southern North Dakota, South Dakota, southern Minnesota and Minneapolis, and between the same points and Duluth, that the railroads have adjusted their rates in a manner unfair to Duluth.†

As a result of the above conditions, Duluth, though enjoying geographically a location which seems to possess the possibilities of development into one of the world's greatest metropolitan centers, is tremendously handicapped. Until such an adjustment of artificial conditions is made which will be consistent with Duluth's natural environment its growth will necessarily be rather slow.

* "A Memorial *in re* Rail and Lake Rates, July, 1910." The Traffic Commission of the Commercial Club of Duluth.

† Report of Hearing of Duluth Shippers before the Interstate Commerce Commission, *Duluth News-Tribune*, Nov. 23, 1911, and other unpublished data.

(To be concluded.)

THE ILLINOIS PETROLEUM FIELDS

BY

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There is no more interesting chapter in the development of American oil fields than that of Illinois. Indeed, its phenomenal growth and rank are unparalleled in this country. Less than eight years ago Illinois was considered unfavorable territory for prospecting because of many unsuccessful attempts to find oil and gas and a prevalent idea that the structure of the State and its relations to the occurrence of oil and gas did not justify the presence of commercial pools. Not only were great fields of high grade petroleum found despite this feeling but also the structure and position of the pools indicate an ideal condition for the accumulation of oil and gas.